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ABSTRACT

This monograph focuses upon the teaching of fractional concepts. The introduction to fractional concepts is treated through sets, number lines, and area. Included are three diagnostic pretests, one of which can be administered to a nonreader. The major core of the monograph consists of 23 worksheets which can be removed for duplication. The worksheets introduce fractional concepts through a variety of exercises involving sets, number lines, areas of figures, linear measures, and tangram activities. (JW)

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AN ACTIVITY APPROACH TO FRACTIONAL CONCEPTS

Monograph No. 5
May 1974

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PREFACE

This is the fifth in a series published by the Guidelines Committee of the Michigan Council of Teachers of Mathematics. This committee is partially financed by the Michigan Education Association.

Our purpose is to provide material that can be used without a great deal of preparation. This material focuses on the teaching of fractional concepts and does not deal with computation. It is intended to be non-graded. The elementary teacher may use but a few pages whereas the teacher in later grades may use quite a bit of the material. It is expected that very few teachers will use all of the material in any given year with a single group of students.

The material is not an "end", but a beginning. The worksheets and suggestions are intended to be "seeds" for you the classroom teacher. We would hope that you would use the material with your students, make improvements, add your suggestions to our list, and build for yourself a usable unit.

We wish to note that the number of pages devoted to a particular phase does not indicate the degree of importance of that phase. Besides, what works for one teacher or learner, does not necessarily work for the next.

Ronald Dirkse - Stevensville

Lou Henkel - Holland

Patricia Kesterke - Alpena

Janet Sullivan - Flint

INTRODUCTION

There are three main ways of introducing fractional concepts to young children: sets, number line, and area. The greatest stress usually is placed on finding fractional parts of a given area. This monograph gives equal weight to using the number line and sets of objects. Closely related to fraction concepts is linear measurement. Because of this we have included a worksheet of rulers and two suggested activity worksheets.

We believe a suitable beginning for any mathematics topic is assessment. Consequently the monograph begins with a suggested pretest for diagnosis. The worksheets can then be best used as prescriptions for your class or individual student work.

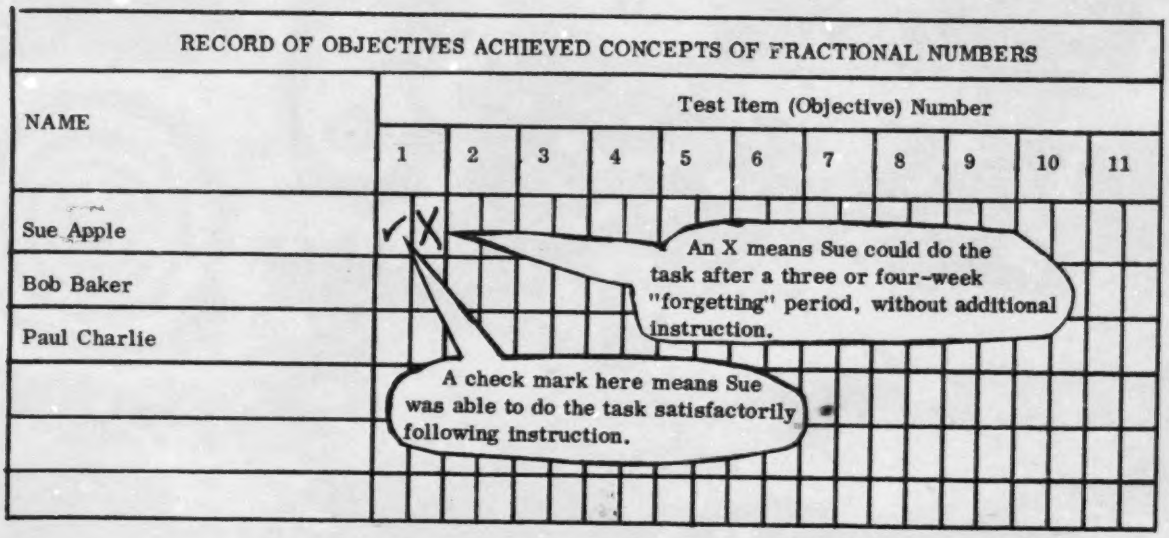
The heart of the monograph is the set of spiritmaster originals that are printed on the center pages for easy removal for duplication. Each teacher can use these as he wishes to meet the needs of his students. The suggestions offered in the monograph are only initial possibilities. Feel free to alter and add to the worksheets as the spirit moves you. Start a fractions concepts folder. We have already added a couple of extras for you: Fraction Circles and Fraction Activities with Tangrams (WS21-24).

Often a complete worksheet is too much for a particular exercise or for the attention span of your students. A neat way to handle this is to make a mask like the one shown below (for Worksheet 17) with sections cut out allowing only a portion of the material to show. Directions and additional problems or questions can be written on the mask if desired. Then run both the mask and the paper through the copy machine at the same time to make the spiritmaster.

A DIAGNOSTIC TESTING PROCEDURE

1. Administer a pretest of a few exercises to determine whether or not the pupil can already perform any of the tasks. Test A and Test B are two equivalent test forms which can be used. Test C is a form of a test that can be administered individually to a nonreader. Answer keys follow at the end of this section.
2. Analyze the test to see what the child seems to be able to do. If he seems competent in one or more of the tasks, check the record of objectives achieved. If the pretest indicates weakness, give the pupil instruction and exercises accordingly. Items on Test A and B are keyed to specific work-sheets at the end of this section. A description of the items on test C are also included.
3. Whether the pupil should be given instruction in all three tasks at the same time (regions, number lines, sets) depends upon his ability and his degree of confusion. Generally speaking, younger children and more confused older ones should be instructed in one type of task until reasonably proficient before moving on to the next task. Older children who are only mildly confused may be given exercises with regions, number lines, and sets at the same time.
4. Teachers are encouraged to set up their own method of evaluating student progress. A suggested system in included here. The record of objectives achieved provides for two entries for each objective. One entry is made when the pupil first demonstrates his ability to do the task. The second

entry is made when he has demonstrated his ability to do the task after a forgetting period.


RECORD OF OBJECTIVES ACHIEVED CONCEPTS OF FRACTIONAL NUMBERS
NAME
Test Item (Objective) Number
1 2 3 4 5 6 7 8 9 10 11
Sue Apple
Bob Baker
Paul Charlie
An X means Sue could do the task after a three or four-week "forgetting" period, without additional instruction.
A check mark here means Sue was able to do the task satisfactorily following instruction.

5. One of the test forms A or B can be used as a posttest. Additional forms of the test can be easily constructed.

Tests A and B Item Description

Problem Number	Item	Given	Worksheet
1.	unit fraction	divided figure	14, 15
2.	non-unit fraction	divided figure	14, 15

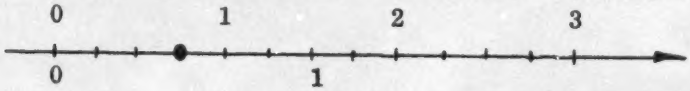
3.	fraction	undivided figure with instruction how to divide	16
4.	fraction	undivided figure without instructions how to divide	16
5.	fraction	scaled number line	5,6,7
6.	fraction	unit number line	4
7.	fraction	unscaled number line	13
8.	unit fraction	set with number of objects same as denominator	1,2,3
9.	fraction	set with number of objects same as denominator	1,2,3
10.	unit fraction	set with number of objects a multiple of the denominator	1,2,3
11.	fraction	set with number of objects a multiple of the denominator	1,2,3

Test C Item Description

Problem Number	Item	Given
1,2	unit fraction	same number of items as the denominator
3,4	non-unit fraction	same number of items as the denominator
5,6	unit fraction	number of items a multiple of the denominator
7,8	non-unit fraction	number of items a multiple of the denominator

ANSWER KEY FOR TEST A

1. One of the three parts are shaded
2. Two of the five parts are shaded
3. The rectangle is divided into eight <u>equal</u> parts and three of them are shaded.
4. The rectangle is divided into four <u>equal</u> parts and two of them are shaded.
5.

6. 

7.

8. One of the circles has a ring around it
9. Three of the triangles have a ring around them
10. Five of the X's have a ring around them
11. Sixteen of the dots have a ring around them

ANSWER KEY FOR TEST B

1. One of the three parts are shaded
2. Three of the eight parts are shaded
3. The rectangle is divided into four <u>equal</u> parts and three of them are shaded
4. The rectangle is divided into eight <u>equal parts</u> and three of them are shaded
5.

6.

7.

8. One of the circles has a ring around it
9. Two of the triangles have a ring around them
10. Three of the X's have a ring around them
11. Six of the dots have a ring around them

ANSWER KEY FOR TEST C

1. One item is selected
2. One item is selected
3. Two items are selected
4. Four items are selected
5. Three items are selected
6. Two items are selected
7. Six items are selected
8. Eight items are selected

TEACHING SUGGESTIONS FOR THE SET WORKSHEETS (WS 1 - 3)

Worksheet 1 (WS 1), consists of sets of figures or shapes arranged in a rectangular array. Using this page the teacher can ask the student to show, by shading, coloring, or marking in some way certain fractions. It is expected that the sheet can be used several times asking various questions. A sequence of questions might go like this:

-- show unit fractions (1/2, 1/4, 1/3, 1/6, 1/9, ...)

-- show any fraction with denominator the same as the number of items.

-- show any fraction that works with the given denominator (1/2; 1/4 or 2/4 or 3/4 or 1/2; 1/3 or 2/3; 1/6, 2/6, 3/6, 4/6 5/6, 1/2, 1/3, 2/3; all ninths, 1/3 or 2/3; all 18ths, 9ths, 6ths, 3rds, 1/2 ...)

-- show equivalent fractions (1/2 on selected items 1,2,7,8. 1/3 on 3,4,5,6)

At this point it should be indicated that the page is arranged as follows:

1. 2	7. 8
2. 4	8. 16
3. 3	9. 6
4. 6	10. 12
5. 9	11. 5
6. 18	12. 10

This arrangement allows the use of just a portion of the sheet at one time. Those denominators which lend themselves to equivalent fractions are grouped together.

After the sheet has been reproduced, the sheet can be cut along the lines if desired. Or the method explained in the introduction can be used.

WS 2 has like figures in each item, but they are not arranged in a regular array. The figures in WS 3 are of different size, shape, and are disarranged. The student is not usually given such items until he is more experienced with the type found on WS 1.

A similar sequence of questions can be asked on WS 2 and WS 3 as were asked on WS 1.

TEACHING SUGGESTIONS FOR NUMBER LINE WORKSHEETS (WS 4 - 13)

The purpose of working with number lines is to make the child aware of order and be able to arrange fractions in sequence. The worksheets are designed for flexibility and a variety of purposes. The arrows on the left of zero have been given to indicate that number lines do not end at zero. WS 4 has unit spacing for

the very beginning processes of ordering and placing fractions. The next five worksheets are not divided in any standard unit. WS 10 is divided into inches, WS 11 into centimeters; WS 12 has the top half divided into inches and the bottom half into centimeters. WS 13 has a zero marked and is otherwise open-ended.

WS 4 is designed for estimating a few basic fractions for the beginning student. Have the student approximate where 1/2 is located; 1/4, etc.

Suggested activities for WS 5-6-7 would be to label 1/2, 2/2, 3/2, etc. on number line 1. Then to compare equivalent fractions, label 2/4, 4/4, 6/4 on number line 2, and so on down the sheet with 3/6 on #4, 9/18 on #6, etc. Since WS 7 has all the number lines equally spaced, one can easily compare which is larger, 1/2 or 3/8?

WS 8 allows the child to estimate the location of a given fraction. The student should be permitted to create his own process of subdividing. Use of a ruler is not recommended.

WS 9 introduces the child to number lines with different unit spacing. Have a child locate 1 on the first eight number lines. For number lines 9 and 10 have each student draw from a box two strips of paper to use as a unit length. Emphasize that unit lengths do vary. Ask how many number lines can be used to locate 1 1/2, 2 1/2, 4 1/4, etc.

WS 10 is divided into inches and can be used in conjunction with measurement in 1/2, 1/4, 1/8, and 1/16 inches. These could also be used as rulers.

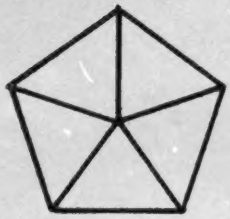
WS 11 has number lines marked in centimeters. Some number lines are divided into 1/2, 1/5, 1/10 centimeters. Some are intentionally left un-numbered

TEST A

1.

Shade 1/3

2.



Shade 2/5

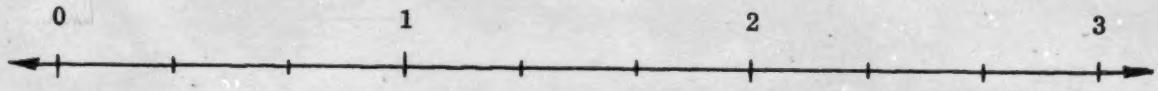
3.

Divide the rectangle into 8 equal parts and shade 3/8 of it.

4.

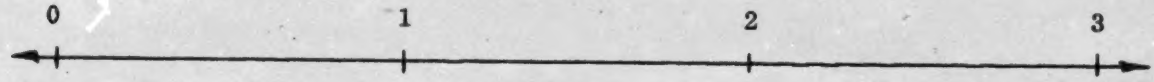
Shade 2/4 of the rectangle

5.



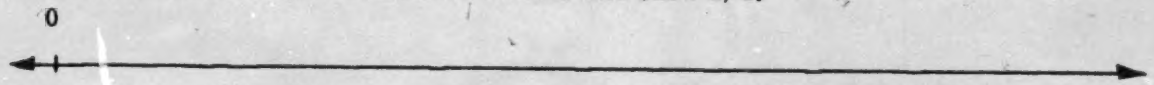
Show where 2/3 is on the number line.

6.



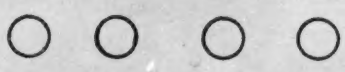
Divide the number line so it shows fourths and show 3/4.

7.



Mark the number line and show 1/3.

8. Draw a ring around 1/4 of the circles.



9. Draw a ring around 3/5 of the triangles.

10. Draw a ring around 1/2 of the X's.

X X X X X X X X X X

11. Draw a ring around 4/5 of the .'s.

. . . . . .

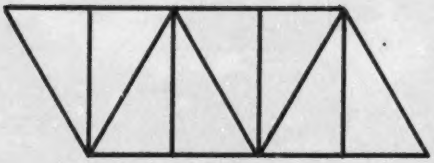
. . . . . .

TEST B

1.

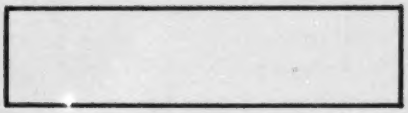
Shade 1/5

2.



Shade 3/8

3.



Divide the rectangle into 4 equal parts and shade 3/4 of it.

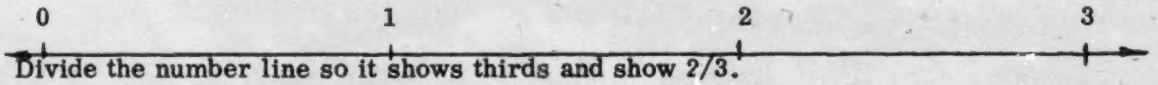
4.

Shade 3/8 of the rectangle.

5.

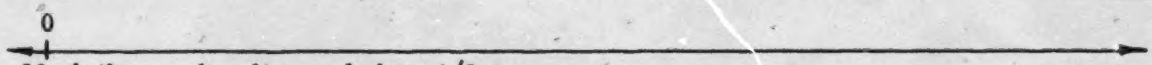
Show where 3/5 is on the number line.

6.



Divide the number line so it shows thirds and show 2/3.

7.



Mark the number line and show 1/2.

8. Draw a ring around 1/3 of the circles. ○ ○ ○

9. Draw a ring around 2/4 of the triangles. △ △ △ △

10. Draw a ring around 1/4 of the X's. X X X X X X X X X X X X

11. Draw a ring around 3/5 of the .'s.

. . . . . .

. . . . . .

TEST C

This is an activity test designed to be given on an individual basis. It is not equivalent to the other forms in that it does not contain experiences related to regions or the number line. It does give the teacher an opportunity to see first hand exactly where the learner is having difficulty.

Note: "Items" refer to any objects which lend themselves to this task, such as blocks, pencils, paper clips, chips, beads, or coffee sticks. Initially, items used in any one problem should be identical.

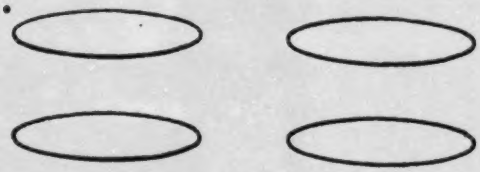
Place on the Table	Say
1. Four items	"Show 1/4"
2. Six items	"Show 1/6"
3. Three items	"Show 2/3"
4. Five items	"Show 4/5"
5. Six items	"Show 1/2"
6. Ten items	"Show 1/5"
7. Eight items	"Show 3/4"
8. Twelve items	"Show 2/3"

RECORD OF OBJECTIVES ACHIEVED CONCEPTS OF FRACTIONAL NUMBERS

NAME	Test Item (Objective) Number										
	1	2	3	4	5	6	7	8	9	10	11

1.

2.



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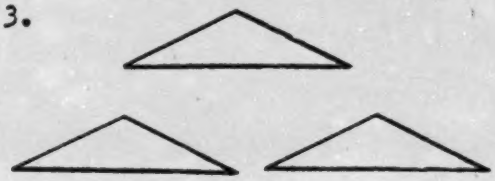

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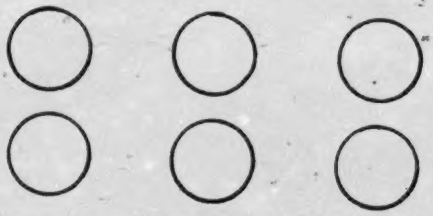

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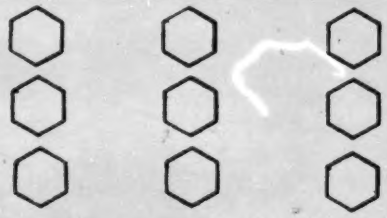


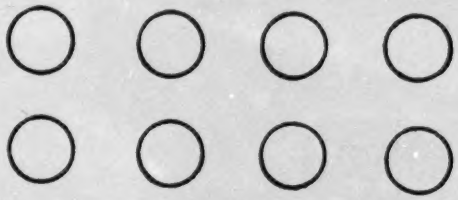
6.

X X X X X X

X X X X X X

X X X X X X

7.



8.

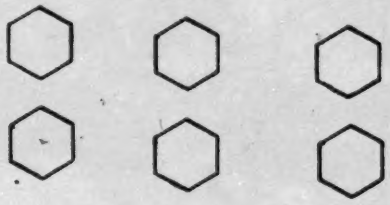
X X X X

X X X X

X X X X

X X X X

9.



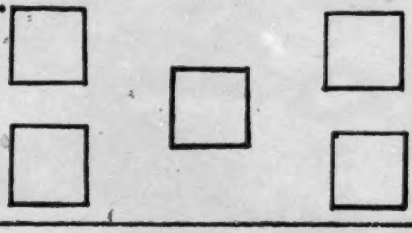
10.

X X X X

X X X X

X X X X

11.



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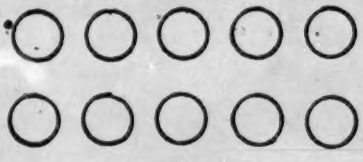

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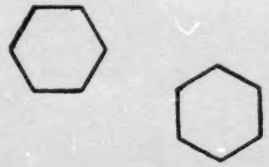

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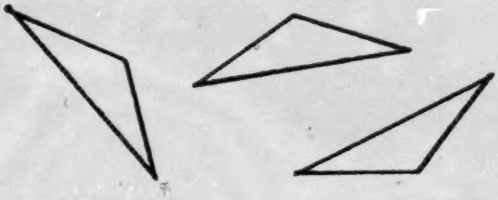

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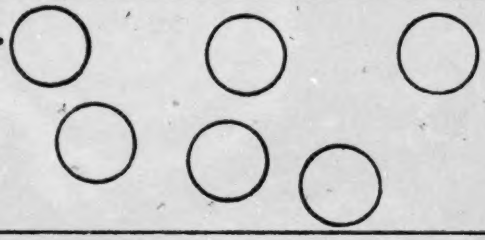

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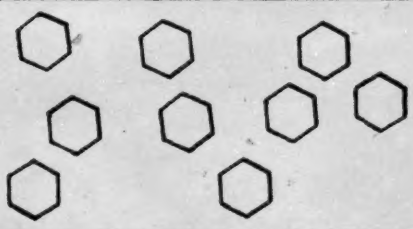

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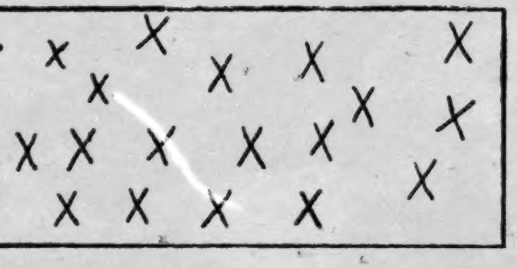

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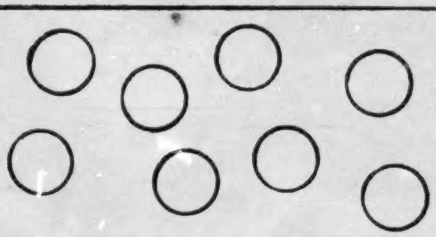

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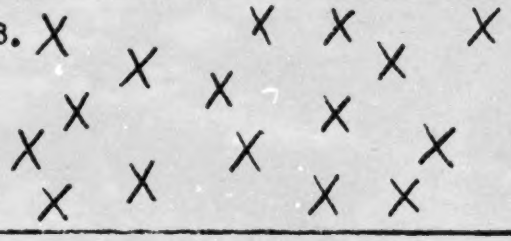

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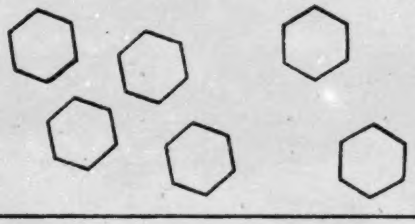

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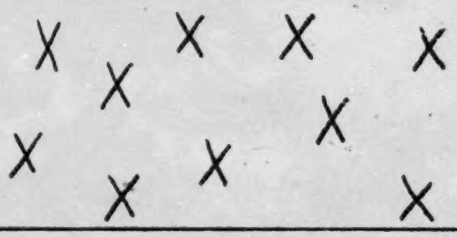

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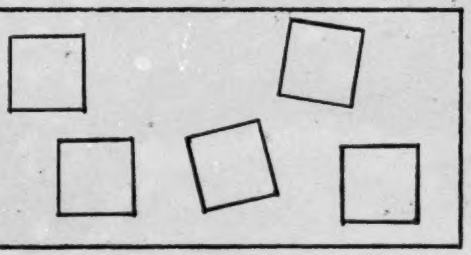

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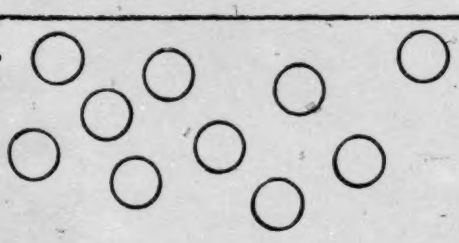

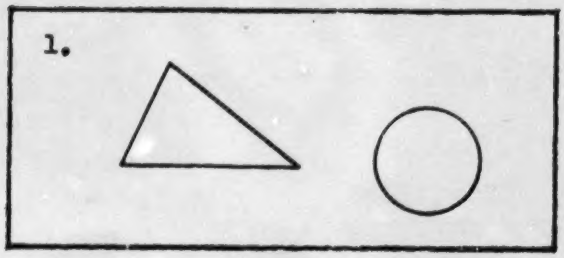
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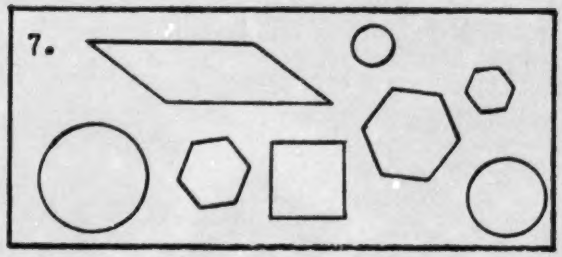
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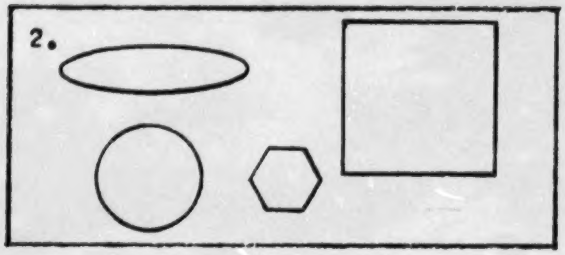
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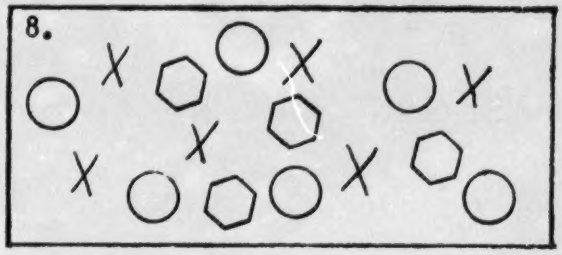
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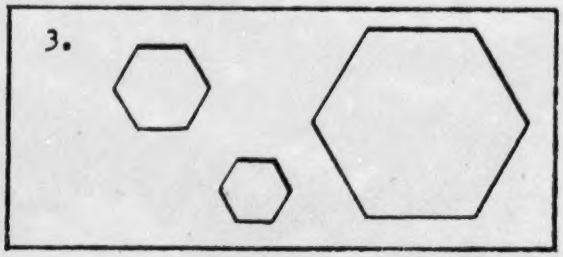
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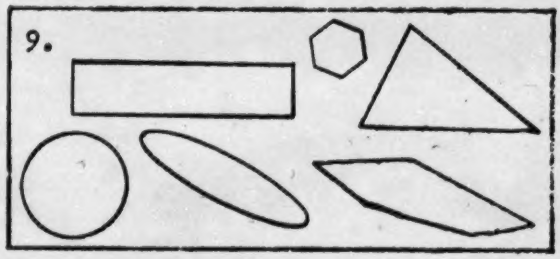
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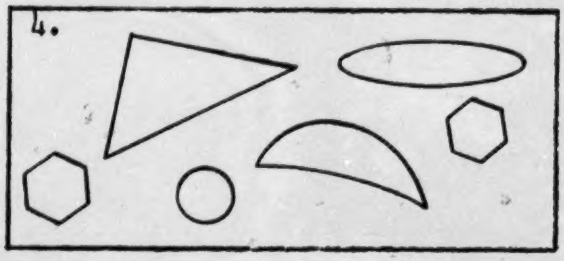
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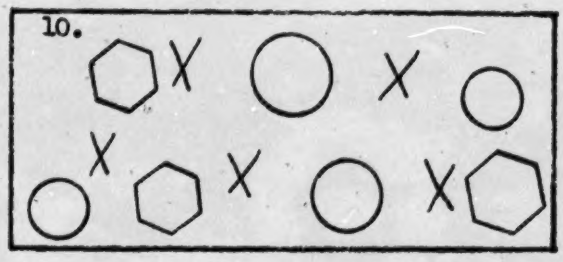
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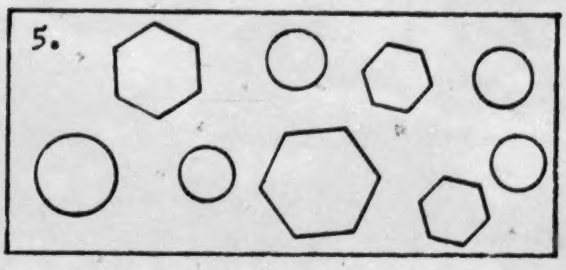
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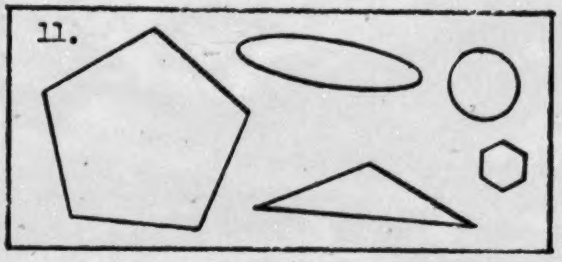
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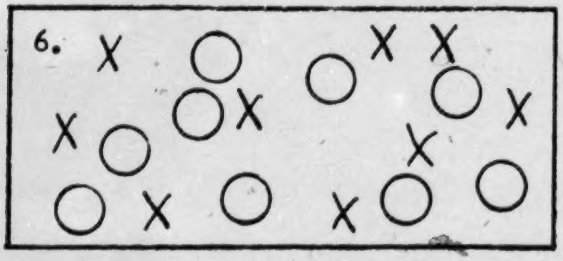
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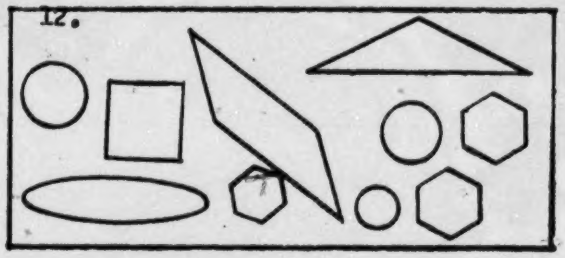
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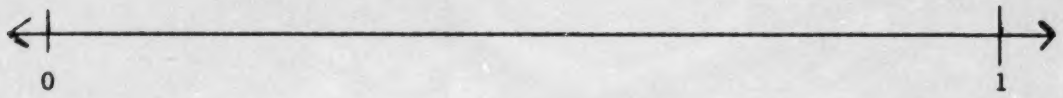
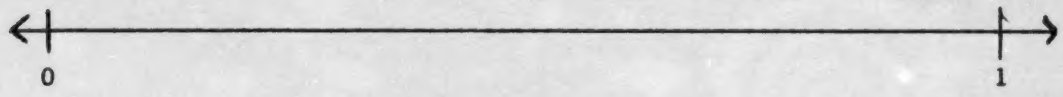
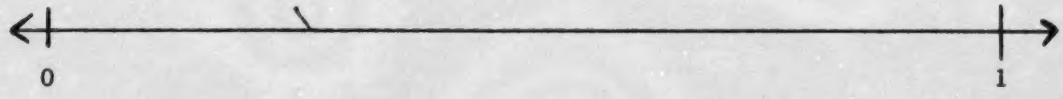
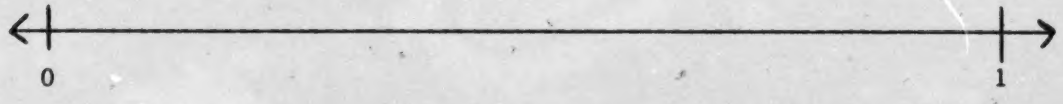
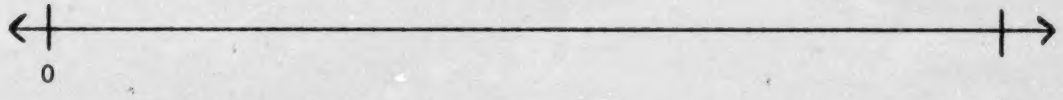
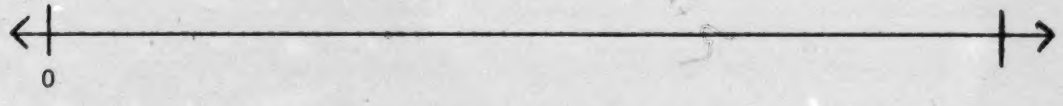
1. 

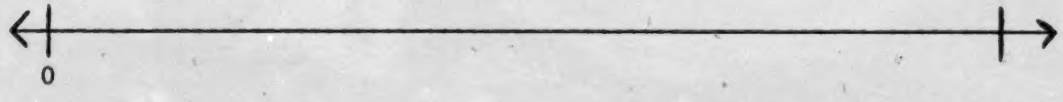
2. 

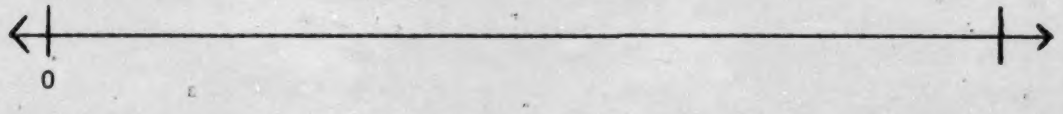
3. 

4. 

5. 

6. 

7. 

8. 

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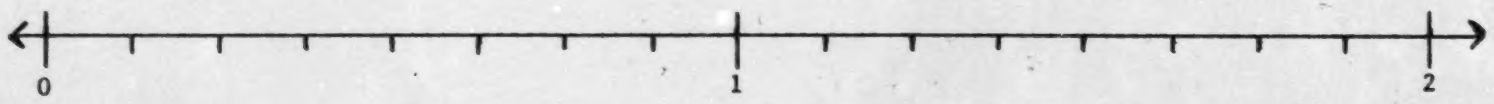
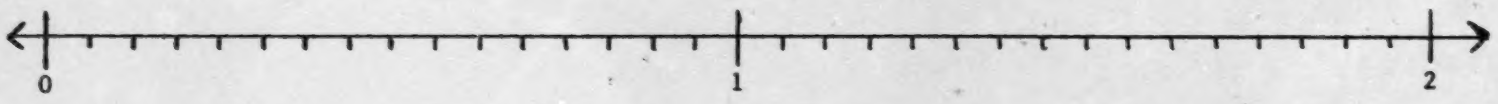
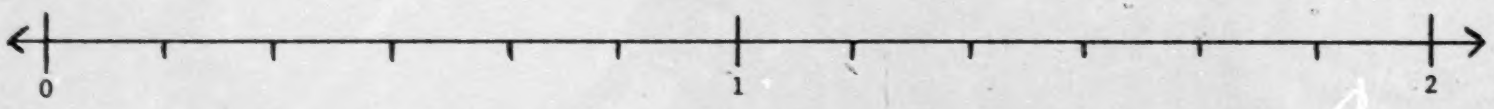
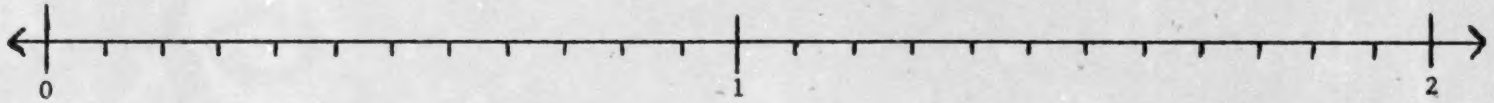
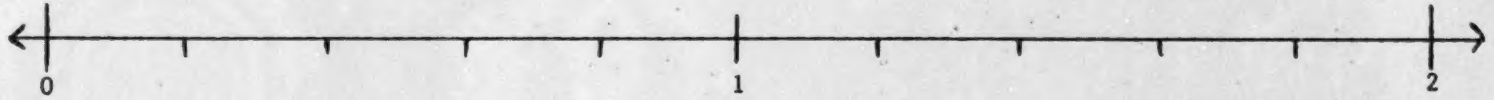
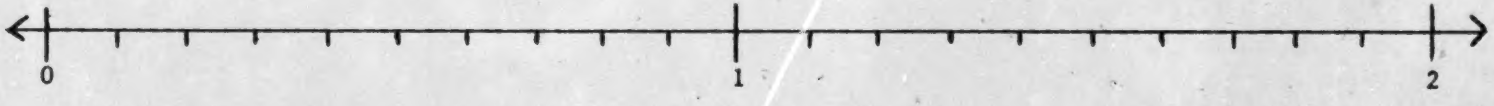
7. 

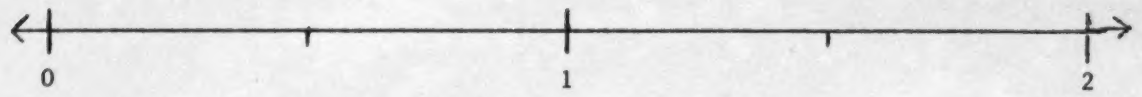
8. 

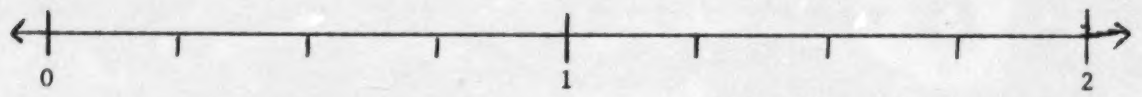
9. 

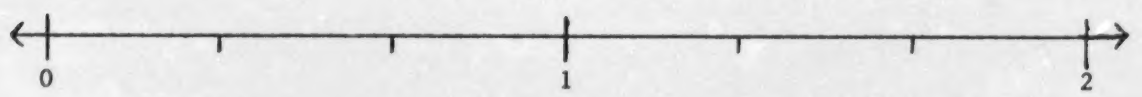
10. 

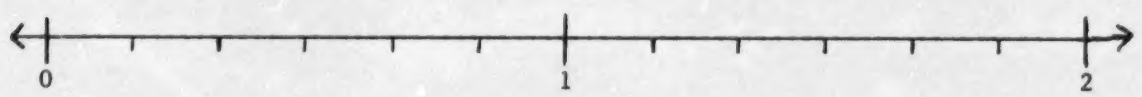
11. 

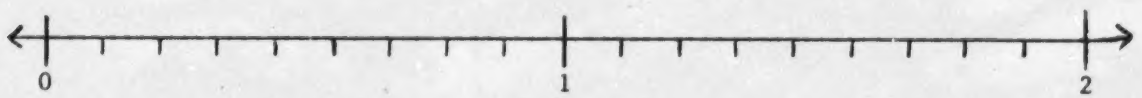
12. 

1. 

2. 

3. 

4. 

5. 

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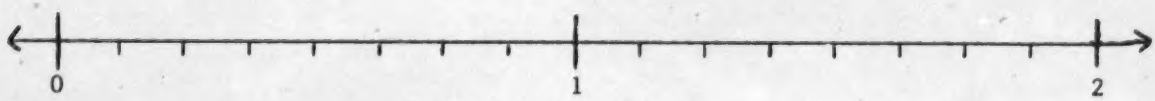
7. 

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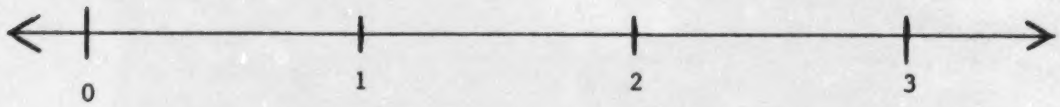
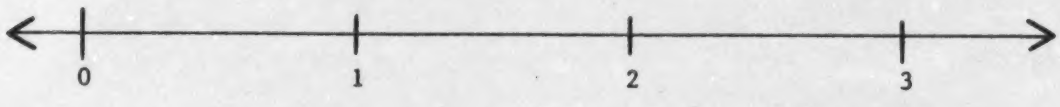
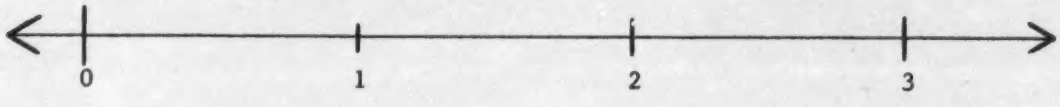
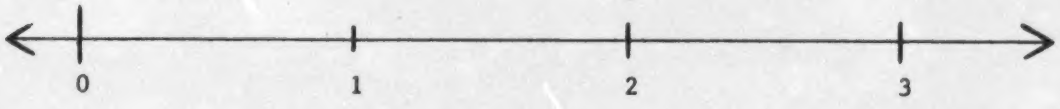
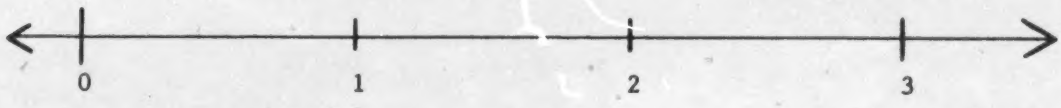
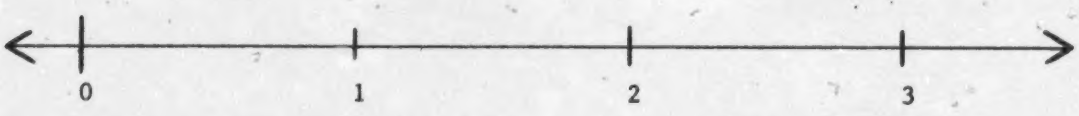
1. 

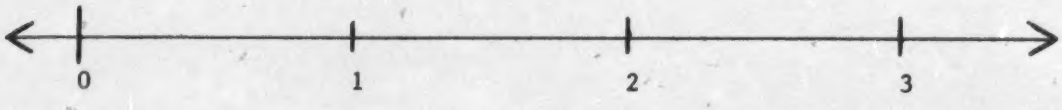
2. 

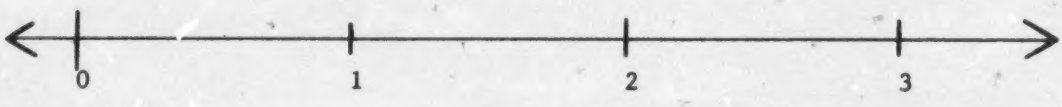
3. 

4. 

5. 

6. 

7. 

8. 

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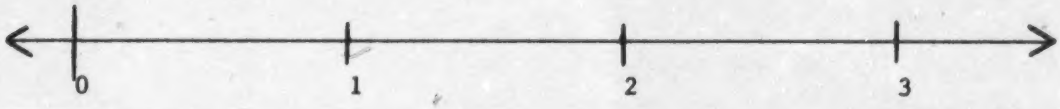
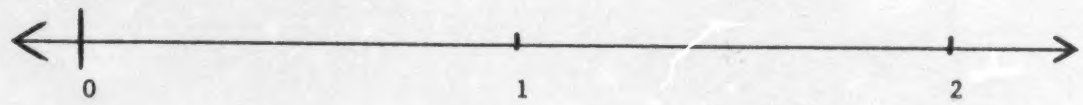
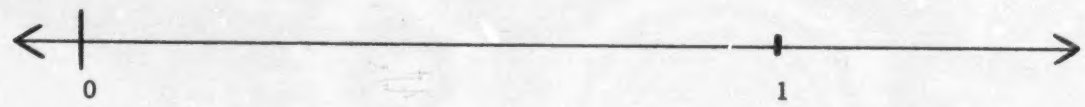
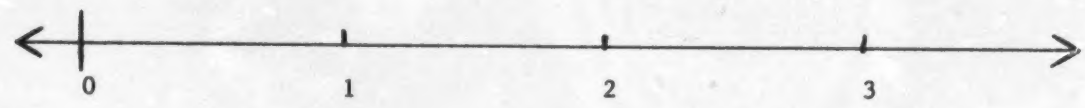
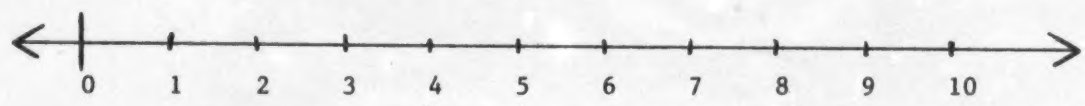
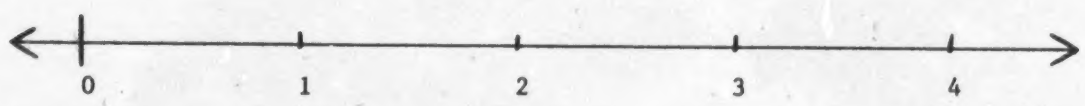
10. 

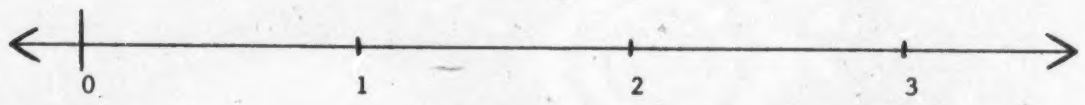
1. 

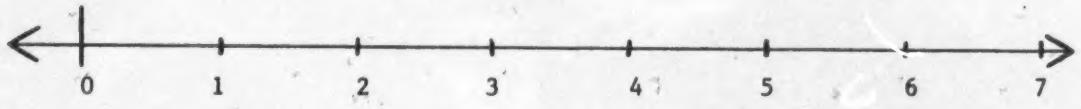
2. 

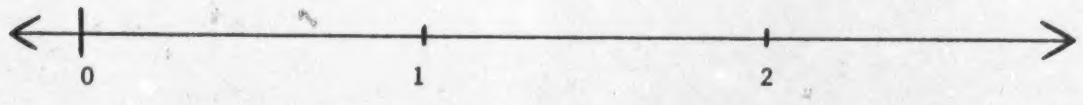
3. 

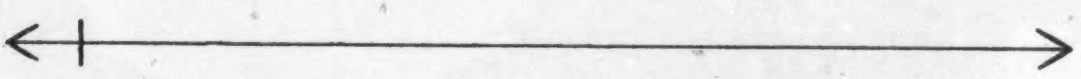
4. 

5. 

6. 

7. 

8. 

9. 

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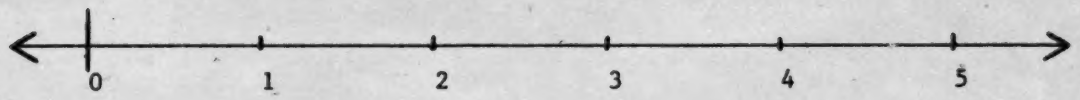
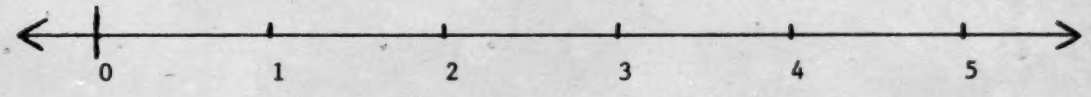
1. 

2. 

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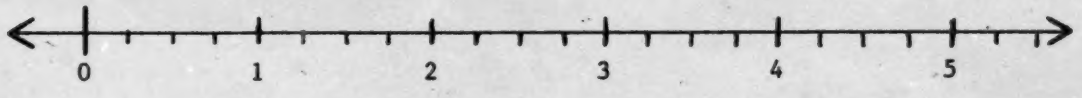
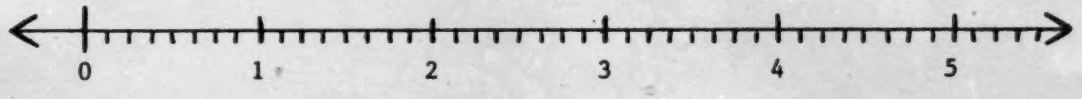
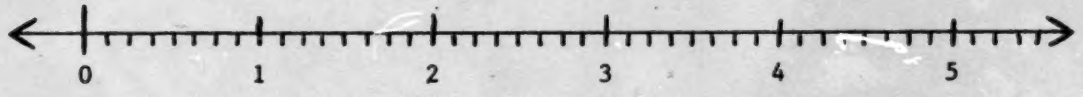
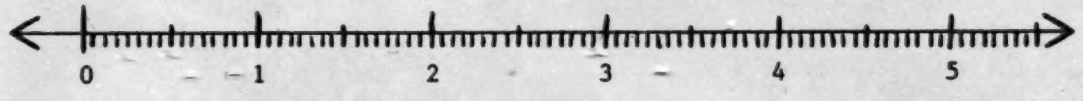
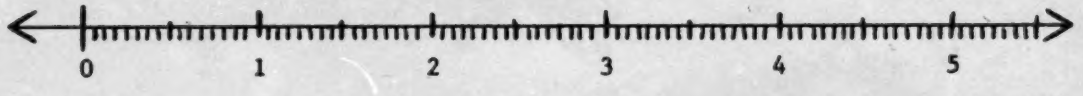
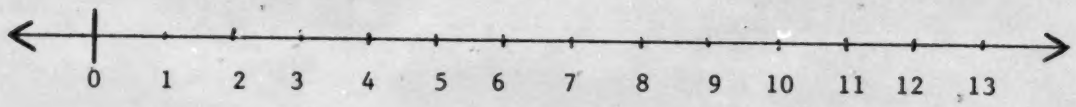
6. 

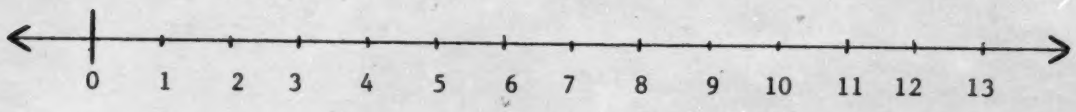
7. 

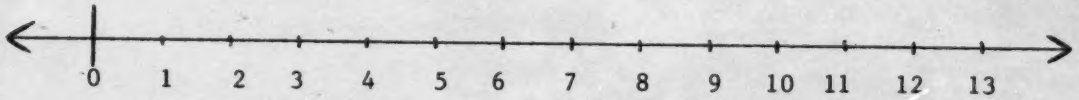
8. 

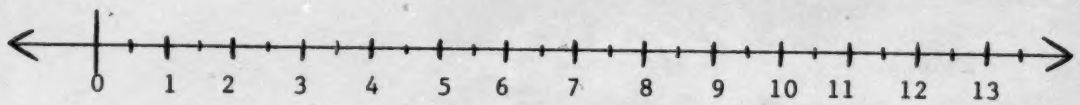
9. 

10. 

1. 

2. 

3. 

4. 

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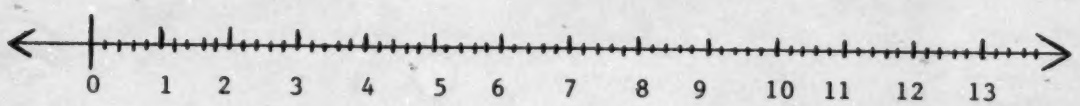
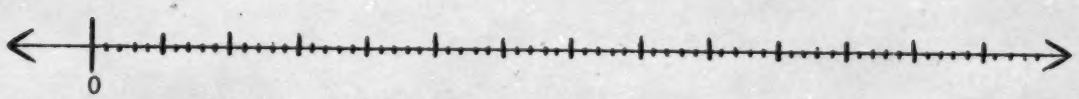
7. 

8. 

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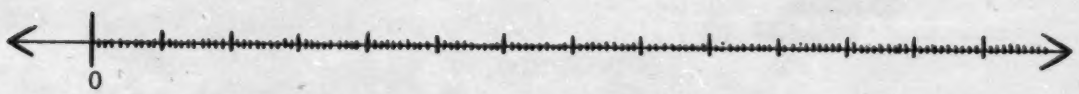
10. 

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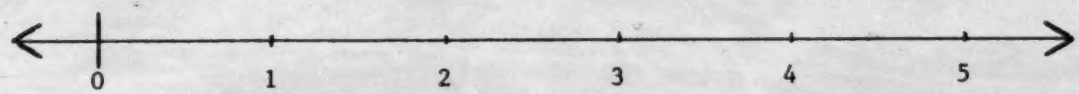
2. 

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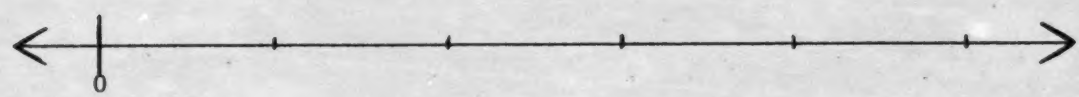
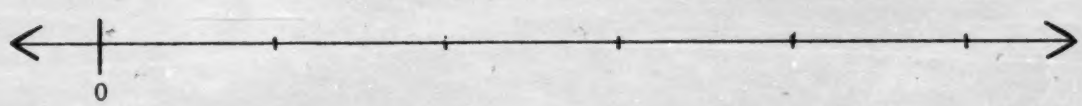
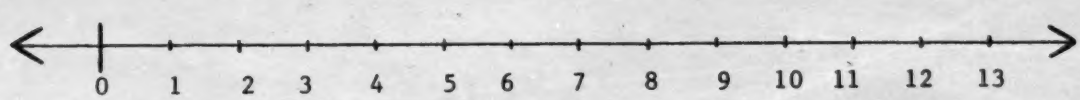
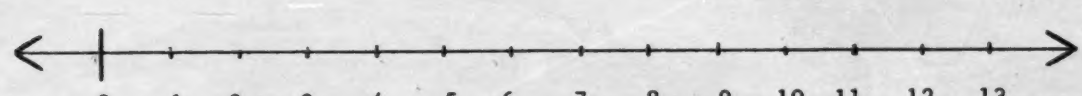
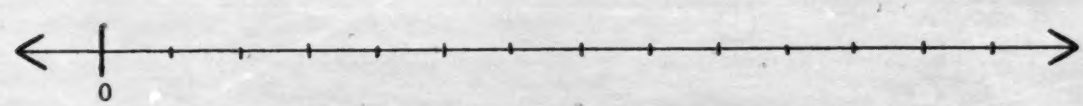
4. 

5. 

6. 

7. 

8. 

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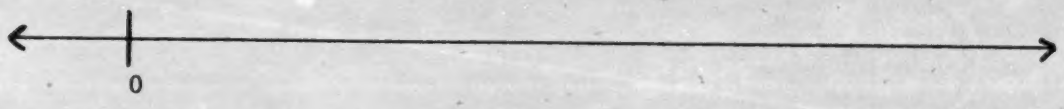
1. 

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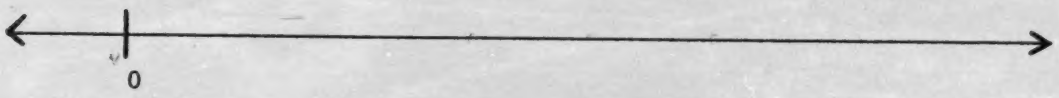
3. 

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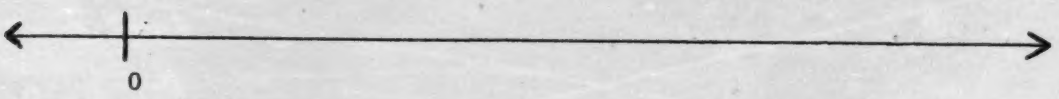
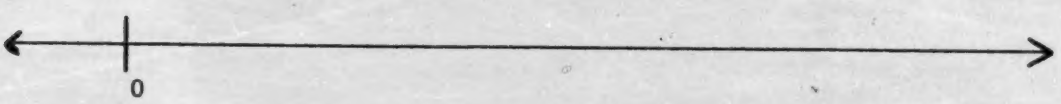
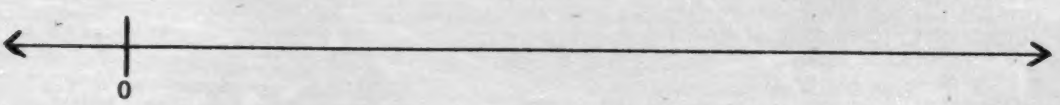
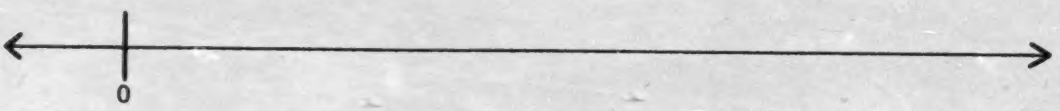
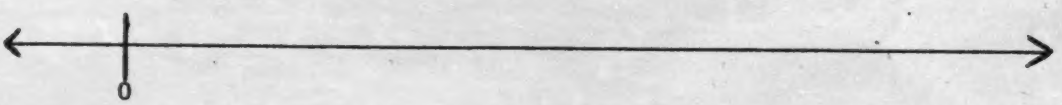
6. 

7. 

8. 

9. 

10. 

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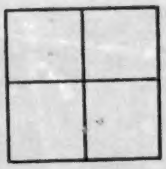
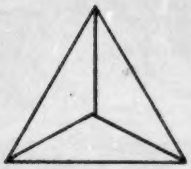
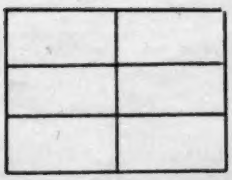
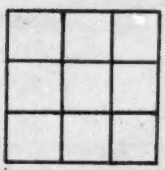
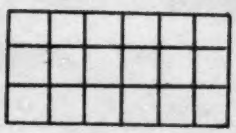
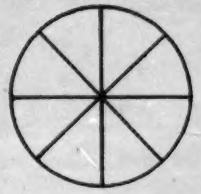
2. 

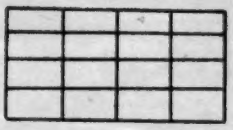
3. 

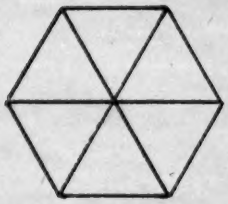
4. 

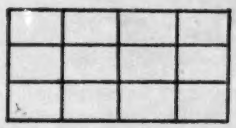
5. 

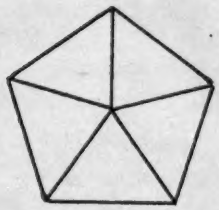
6. 

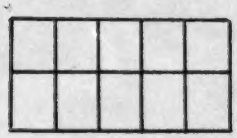
7. 

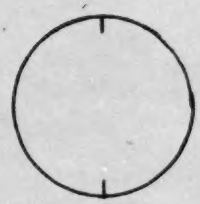
8. 

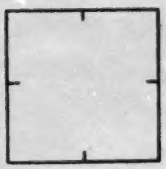
9. 

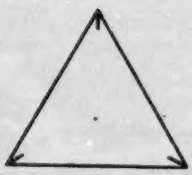
10. 

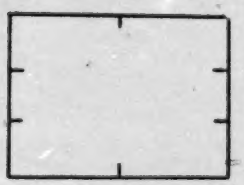
11. 

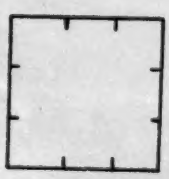
12. 

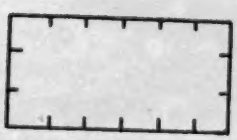
1. 

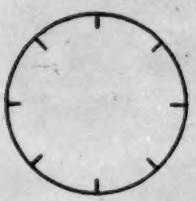
2. 

3. 

4. 

5. 

6. 

7. 

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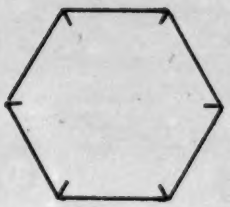
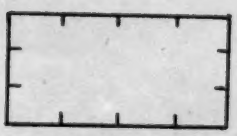
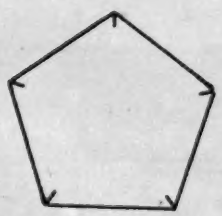
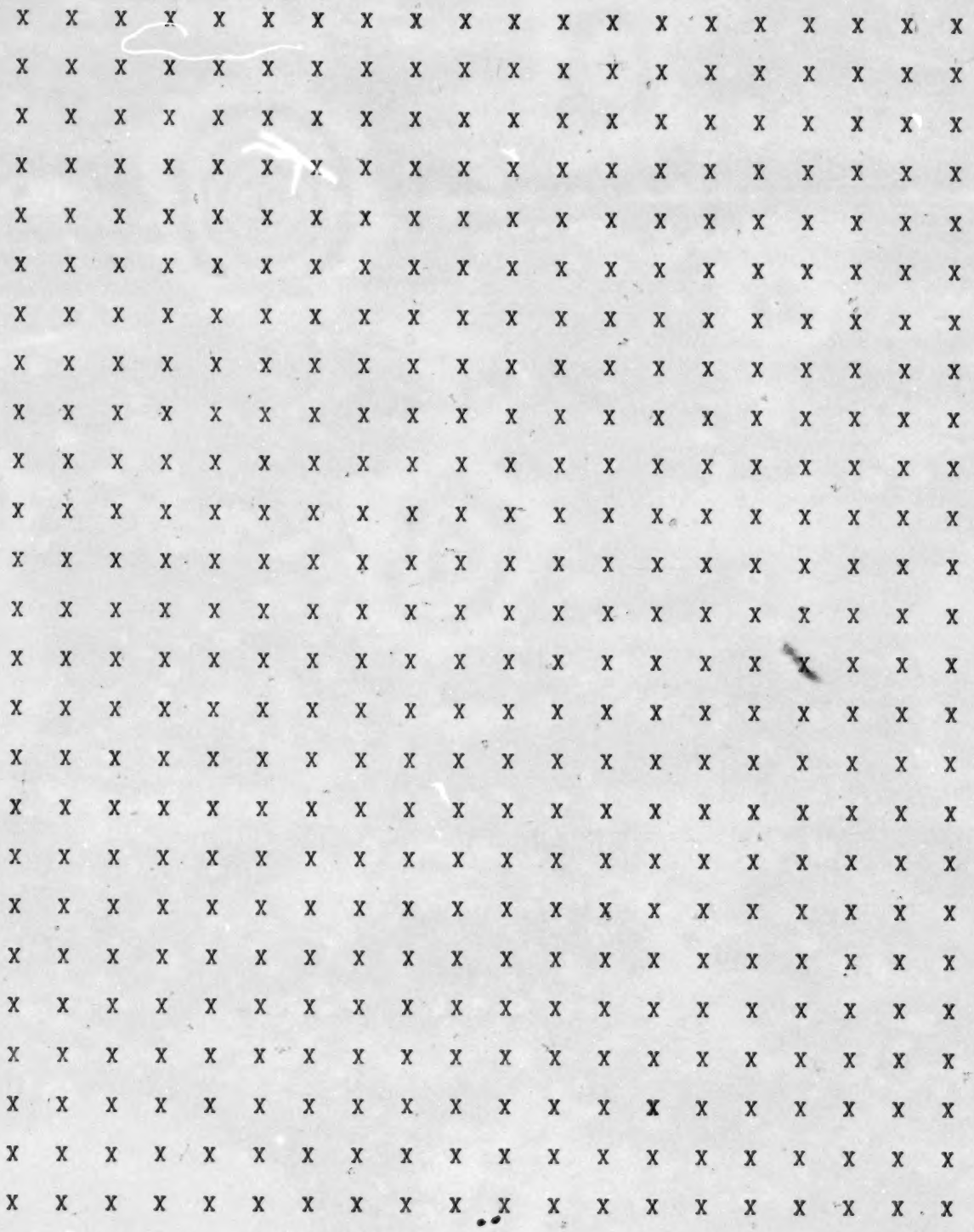
9. 

10. 

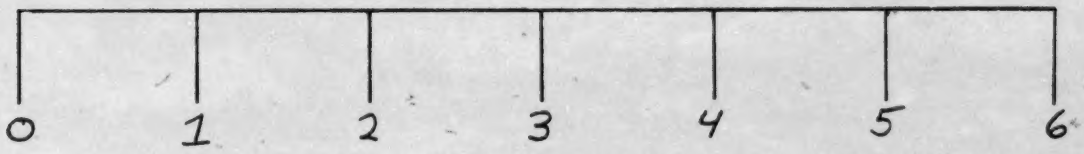
11. 

12.

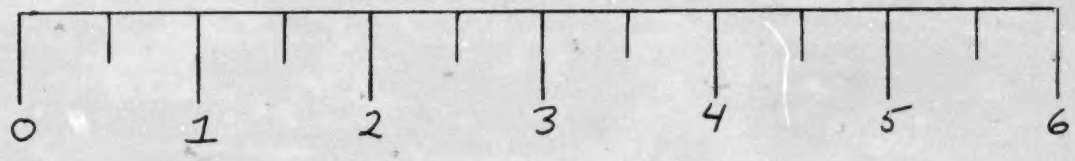
A	B	C
1.	1.	1.
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.
6.	6.	6.
7.	7.	7.
8.	8.	8.



INCH



HALF INCH



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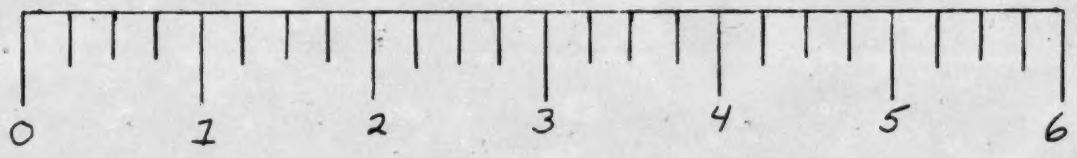
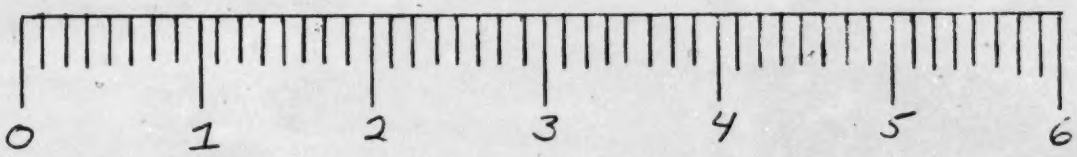
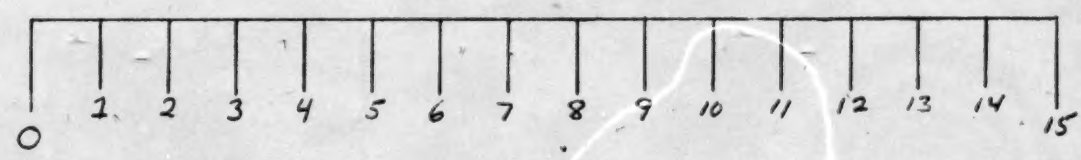


EIGHTH INCH

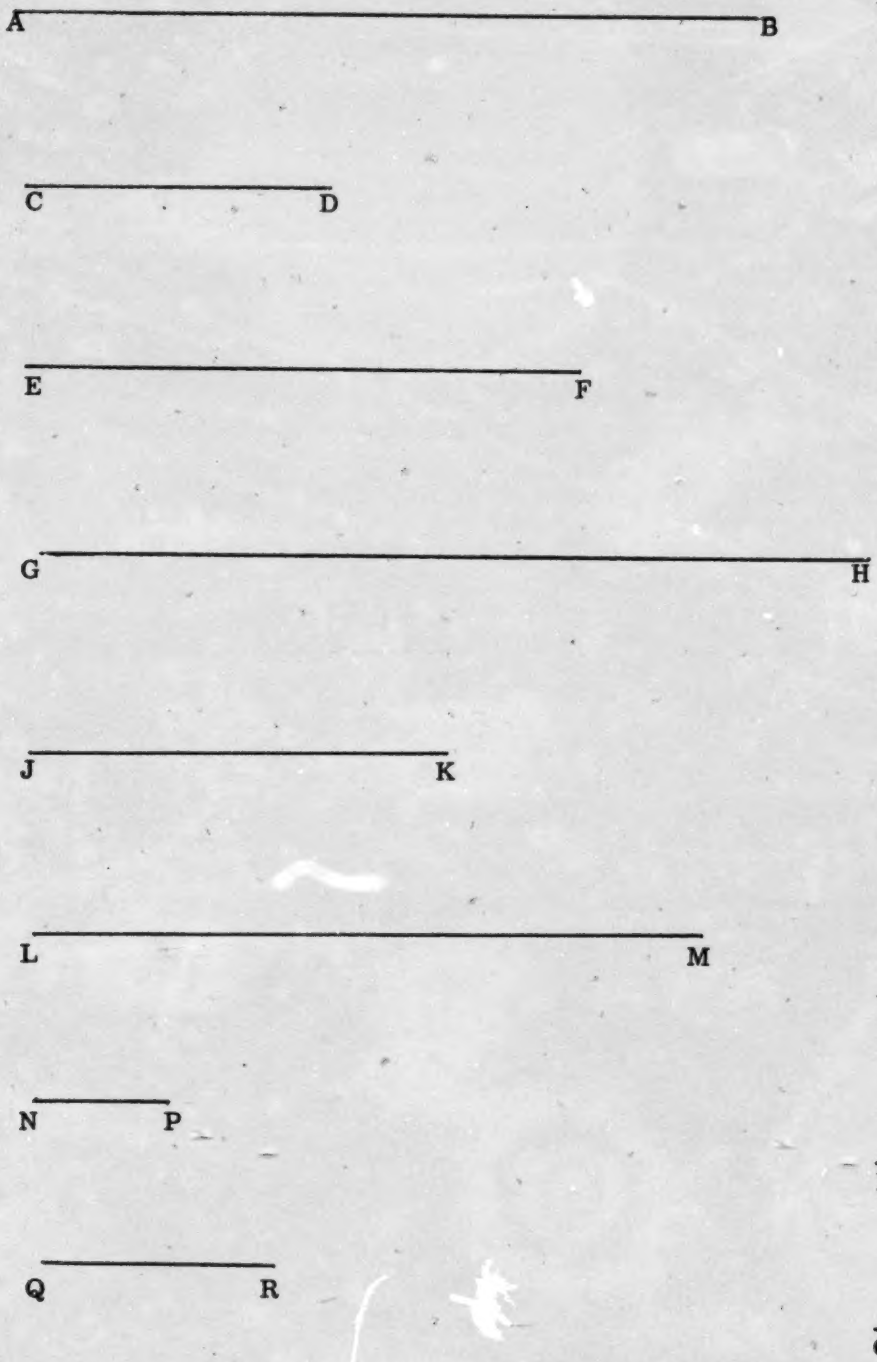


SIXTEENTH INCH

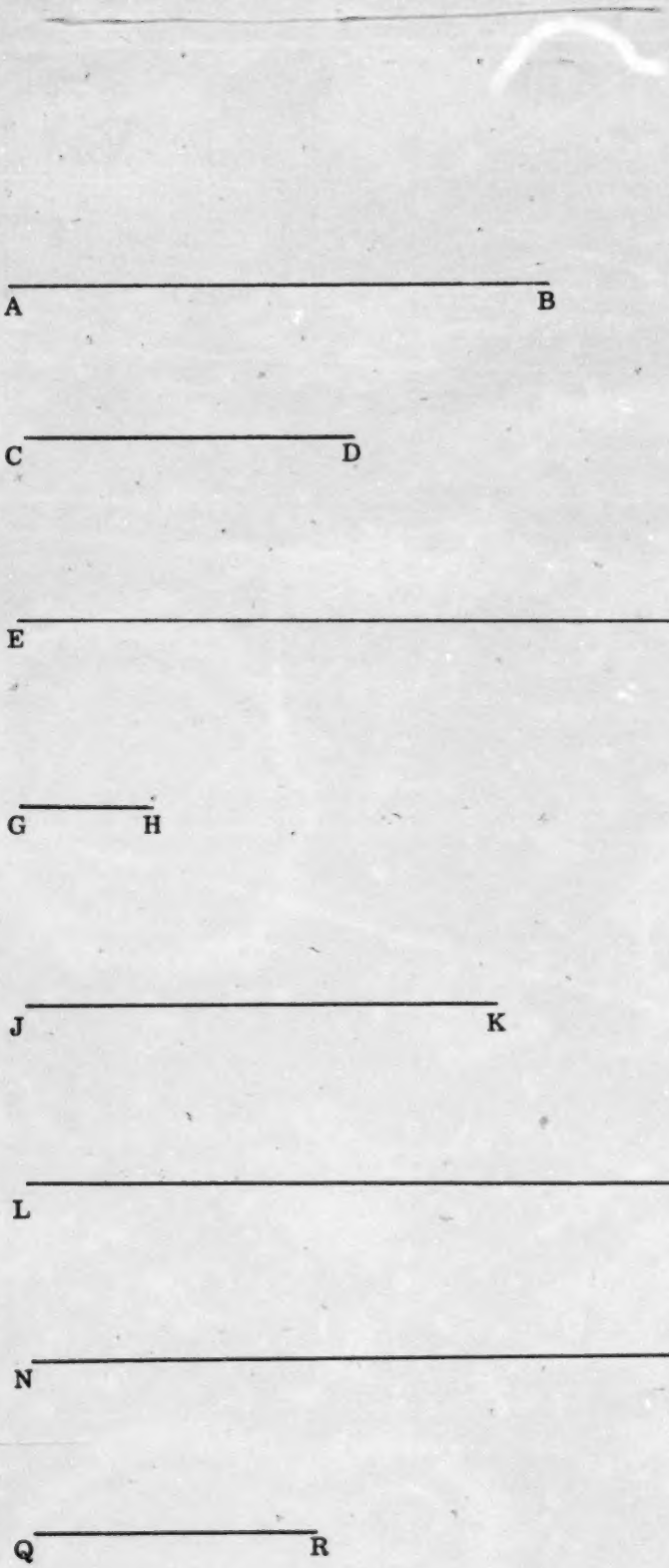
CENTIMETER



MILLIMETER

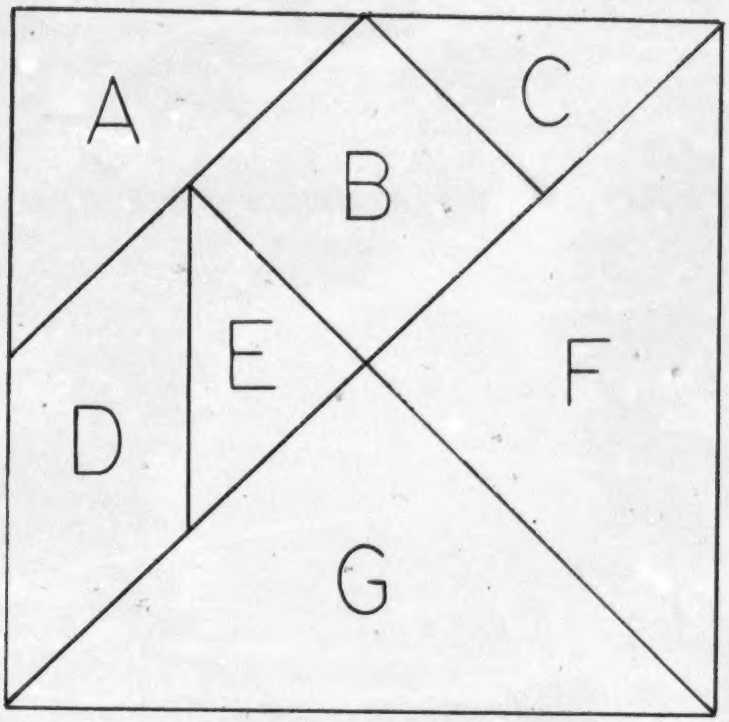


	INCH	HALF INCH	FOURTHS OF AN INCH	EIGHTHS OF AN INCH
$\overline{AB}$				
$\overline{CD}$				
$\overline{EF}$				
$\overline{GH}$				
$\overline{JK}$				
$\overline{LM}$				
$\overline{NP}$				
$\overline{QR}$				



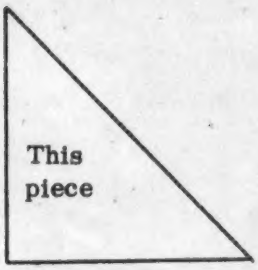
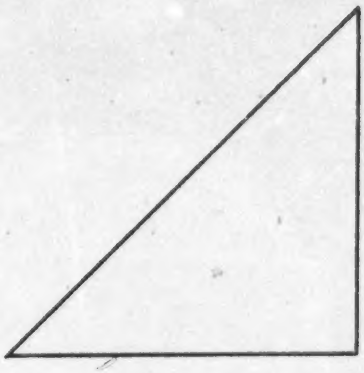
	CENTI-METERS	MILLI-METERS
$\overline{AB}$		
$\overline{CD}$		
$\overline{EF}$		
$\overline{GH}$		
$\overline{JK}$		
$\overline{LM}$		
$\overline{NP}$		
$\overline{QR}$		

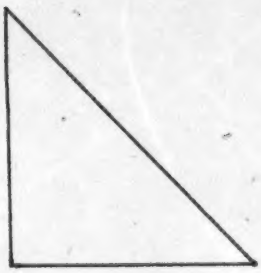
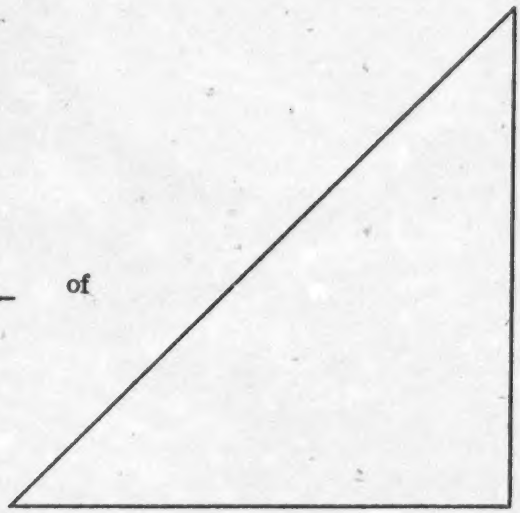
TANGRAMS

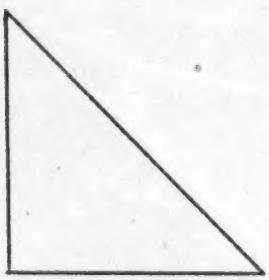
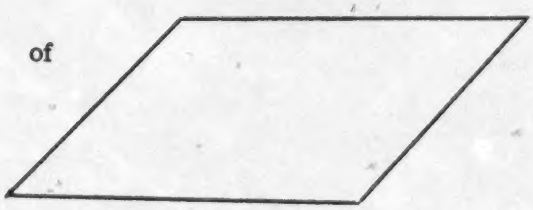


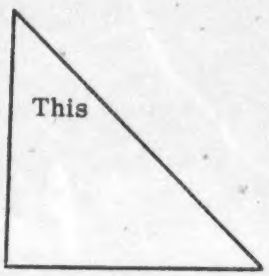
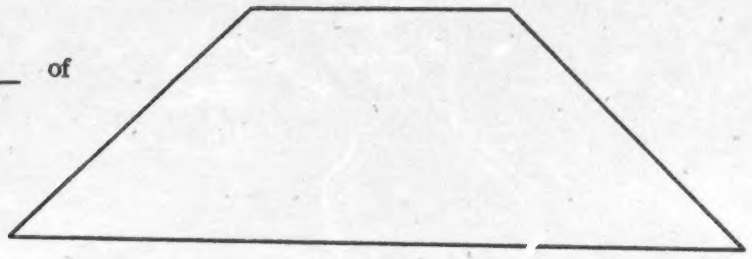
CUT THE SEVEN PIECES OUT ALONG THE LINES TO HELP YOU ANSWER THE FOLLOWING:

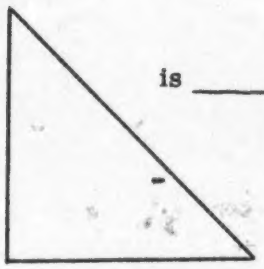
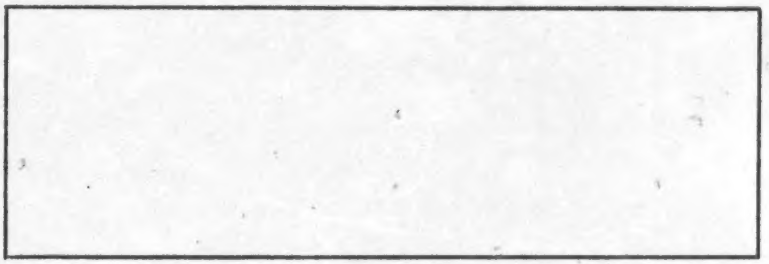
1. C is _____ of B
2. C is _____ of F
3. C is _____ of A
4. E is _____ of D
5. D is _____ of B
6. D is _____ of G
7. A is _____ of G
8. G is _____ of the big square
9. If F is 2, what is E? _____
10. If D is 3, what is G? _____

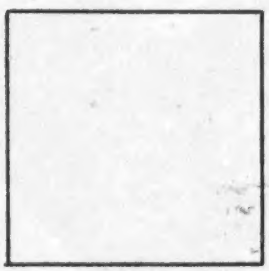
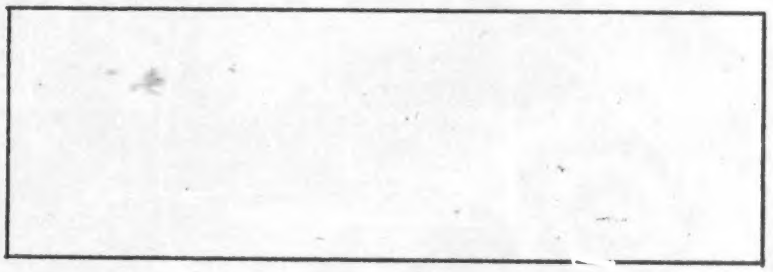
1. This piece  is _____ (what fraction) of 

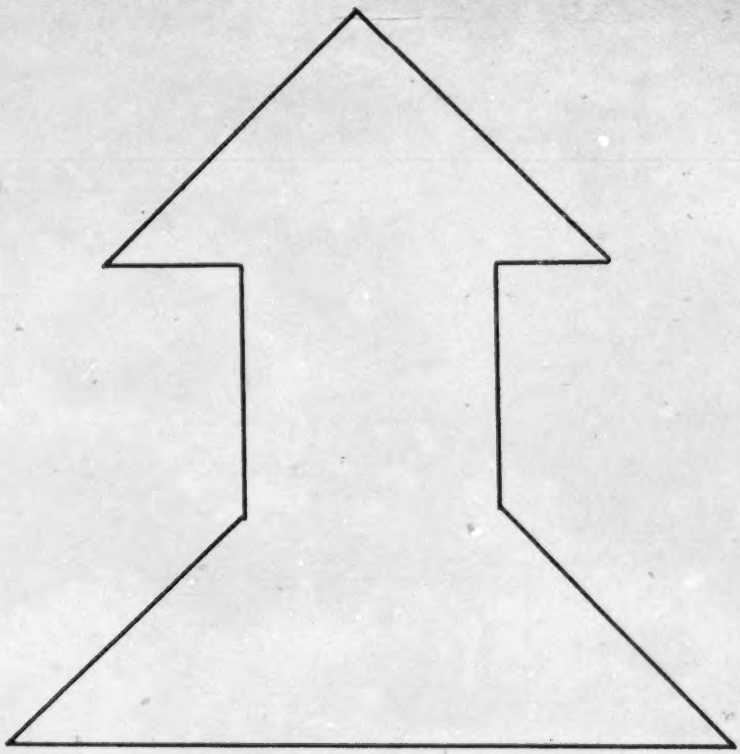
2.  is _____ of 

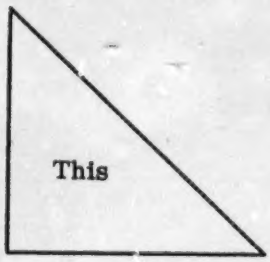
3.  is _____ of 

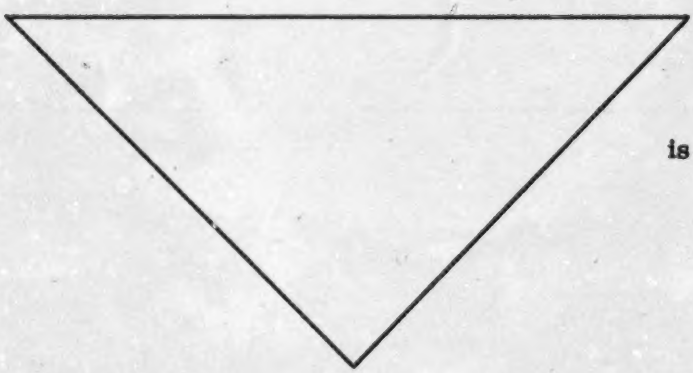
1. This  is _____ of 

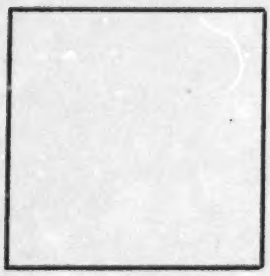
2.  is _____ of 

3.  is _____ of 



1. 
This is _____ of the shape at the top of the page
(what fraction)

2. 
is _____ of the shape at the top of the page

3. 
is _____ of the shape at the top of the page

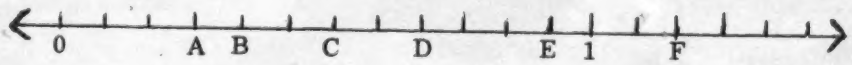
to allow flexibility in numbering. Number line 10 could be numbered to 139. Again these could be used for rulers.

WS 12 is again one in which the children are encouraged to estimate the location of 1/2 or 3/4, etc.

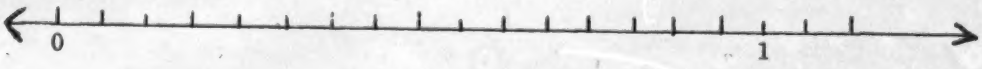
WS 13 has unmarked lines and permits the student to divide the line into six equal parts and mark 5/6, or divide it into twelve equal parts and mark 1/3, etc.

In addition to having the child place fractions on the lines, it is also hoped that the teacher would place letters A, B, C, ...on different places on the lines and have the children estimate what fraction is represented.

Examples: Name the fractions indicated by the letters



Graph and label 1/8, 1/4, 5/16, 1/2, 3/4, 3/8, 7/8



TEACHING SUGGESTIONS FOR REGION WORKSHEETS (WS 14 - 16)

The worksheets with regions follow the same pattern as the worksheets on sets, i.e. the number of objects on the set sheets is the same as the number of parts on the region sheets. Students will show a correct number of parts for the given fraction.

WS 14 shows various shapes with the parts drawn in.

WS 15 has the same shapes as WS 14, but the marks are given to help the student.

WS 16 has 24 rectangles which can be divided into any number of parts and

shaded in various ways. By using a paper cutter these can be done one column at a time, or equivalent fractions can be shown in different ways in each column.

AN ADDITIONAL ACTIVITY

This activity uses all three ways of illustrating fractions. It consists of sets of questions that can be used interchangeably with the following worksheets: WS 1, 2, 3, 5, 6, 7, 14, 15. The question can be given orally or used on the overhead projector. The student is to shade, circle, or indicate the given fraction as the teacher directs.

The fraction given in question sets A, B, and C have denominators the same as the number of parts. As the student's knowledge of fractions increases, a more difficult task would be to find equivalent fractions in the set.

The fractions in sets D through I have denominators different from the number of parts shown.

IMPORTANT: It is suggested that the student be given sheets showing sets, number lines, and regions, and asked to answer the same question for all three sheets noting the similarity of what they are doing on each.

The number of ways that these worksheets can be used in the classroom are limited only by the teacher's resourcefulness. In compiling these worksheets we have tried to consider many possible combinations. As indicated above, WS 1, 2, 3, 14, 15, are all laid out in a similar manner so that the same questions can be used on all five, plus the number line worksheets 5, 6, and 7.

The worksheets can be cut so that only portions are used in one day. In

this manner the student does not tire as easily of doing such work. It could also be used as a review at a later date. The arrangement appears below for WS 1, 2, 3, 14, 15, with the suggested cutting places indicated.

1. 2	7. 8
2. 4	8. 16
3. 3	9. 6
4. 6	10. 12
5. 9	11. 5
6. 18	12. 10

As an alternative to cutting the worksheets, a mask can be used as explained in the introduction.

SHOW: By shading or coloring.
By drawing a line through.
By circling.

SET A.	SHOW
1. 1/2	1/2
2. 2/4	
3. 1/3	1/3
4. 3/6	1/2
5. 3/9	1/3
6. 9/18	1/2
7. 4/8	
8. 8/16	
9. 3/6	
10. 6/12	
11. 2/5	2/5
12. 5/10	1/2

SET B.	SHOW
1. 1/2	
2. 1/4	1/4
3. 1/3	1/3
4. 4/6	
5. 3/9	
6. 6/18	
7. 2/8	1/4
8. 4/16	
9. 2/6	1/3
10. 8/12	
11. 3/5	3/5
12. 6/10	

SET C.	SHOW
1. 2/2	1
2. 3/4	3/4
3. 3/3	1
4. 5/6	5/6
5. 9/9	1
6. 15/18	5/6
7. 6/8	3/4
8. 12/16	
9. 5/6	5/6
10. 10/12	
11. 0/5	0
12. 0/10	

SET D.	SHOW	SET E.	SHOW	SET F.	SHOW
1. 2/2		1. 0/2		1. 2/2	
2. 1/2		2. 1/4		2. 1/2	
3. 1/3		3. 1/3		3. 0/3	
4. 1/2		4. 1/3		4. 2/3	
5. 1/3		5. 1/3		5. 2/3	
6. 1/2		6. 1/3		6. 4/6	
7. 1/2		7. 1/4		7. 3/4	
8. 1/2		8. 1/4		8. 5/8	
9. 1/2		9. 1/3		9. 1/6	
10. 1/2		10. 1/3		10. 3/4	
11. 1		11. 1/5		11. 0/5	
12. 1/2		12. 1/5		12. 3/5	

SET G.	SHOW	SET H.	SHOW	SET I.	SHOW
1. 1		1. 0		1. 1/2	
2. 2/4		2. 2/2		2. 1/2	
3. 0		3. 1		3. 2/3	
4. 5/6		4. 0/6		4. 1/3	
5. 3/3		5. 0		5. 2/3	
6. 2/3		6. 6/6		6. 2/6	
7. 3/4		7. 4/4		7. 5/8	
8. 3/4		8. 2/2		8. 3/4	
9. 2/3		9. 3/3		9. 1/2	
10. 3/6		10. 4/4		10. 5/6	
11. 1		11. 0		11. 4/5	
12. 5/5		12. 5/5		12. 4/5	

COMMENTS ON WS 17

WS 17 consists of 500 x's arranged in a 25 X 20 array.

1. By sectioning off portions of this array as explained in the introduction, fractions with denominators other than those used on the worksheets can be shown.

2. Using five rows or four columns, or a 10 X 10 array, a per cent model can be created. Graph paper can also be used for this.

3. Also, exercises can be created to illustrate equivalent fractions.

COMMENTS ON THE USE OF WS 18 - 20, LINEAR MEASURE

One of the most common uses of fractions is measuring with a ruler. Typically the student is asked to measure the length of an object or a line with a ruler scaled in sixteenths. This request often leads to difficulty because the student does not know the names of the divisions. What follows is one approach to the teaching of this topic.

Regardless of grade level, the ability to measure varies, especially in the middle or upper grades. A short pretest will determine individual abilities.

PRETEST: Cut from a coat hanger five lengths of wire 2 to 6 inches in length. Care should be taken to force the use of a variety of fractions: i.e. 2 1/4, 2 13/16, 3 1/2, 5, 5 3/8, (achievement level of the learner should be considered at this point). Label each wire with masking tape using the letters A, B, C, D, E. Place the wires on a table at the side of the room and have each student individually measure the wires and turn in his answer sheet. This pretest can be done with or without prior instruction on the use of the ruler. The ability of the learner would help decide this option. This could be accomplished while the group is working on another assignment a week or two prior to the time that the teaching of the ruler is scheduled.

The results of this pretest will determine the kind and depth of instruction required. Most often students fall into two groups: those who need a little brushing

up, and those who need HELP!! The worksheets are intended for the latter group.

Step 1 Using WS 19 and a ruler scaled in 1/2 inches (WS 18), each student measures each line to the nearest inch and has his answers corrected. The student does not begin work on the next column until he has all answers in the first column correct.

Step 2 Using a ruler scaled in 1/4 inches, each student measures each line to the nearest half-inch and has his answers corrected. The student does not go on to the next column until all of these answers are correct.

Most students who have had some experience with measuring will get this far without a great deal of difficulty. It is measuring to the nearest quarter inch and nearest eighth-inch that gives trouble. Therefore, stopping at this point and reviewing material covered and procedures is time well spent.

Steps 3 and 4 will follow the above pattern using columns 3 and 4. Consideration should be given to doing one or two columns at a time, depending on the degree of interest and concentration power of the learner.

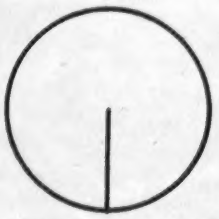
A single exposure to measurement is not adequate. Additional and varied experiences with measuring should be provided at a later time to review and reinforce learning.

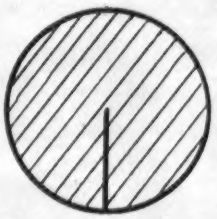
Rulers such as the ones shown on WS 18 are available commercially and are preferred. One alternative is to copy the worksheet, laminate if possible, and cut out each ruler. Or you can use the page as it appears, folding as necessary.

WS 20 would be used in a similar manner, first completing the centimeter column for all segments. Then, after all centimeter answers have been done correctly, the student can go on to the millimeter column. It might be advisable to allow an "error" of one or two millimeters, since a millimeter is a very small unit.

FRACTION CIRCLES

Prepare two circles of contrasting colors, for each student. Cut a radius on each. We recommend at least a 10 centimeter radius.





Fit the two circles together at the slit so that they overlap.

The fraction circle is very useful without any markings for students to get a feeling for fractions. You are able to quickly check concept understanding without paper and pencil. Suppose the circles are blue and yellow, you can ask: "Make your wheel 1/4 yellow and hold up". . . ."great". . . ."Make your circles 2/3 blue, hold up". . .' etc. You can tell at a glance which of your students are having difficulty.

By marking divisions on one circle you can be more specific -- you can

even put degrees on.

Some kids like to play an E.S.P. game with these circles -- let your students make up their own games.

Lamination will preserve the fraction units, but it is expensive.

FRACTION ACTIVITIES WITH TANGRAMS (WS 21- 24)

WS 21-24 provide an unique approach to fractional concepts. Although most students will enjoy this activity, not all students will grasp the fractional implications.

East student must have his own copy of WS 21 to be cut out. The pieces are then used to answer the ten questions at the bottom of the page and the problems on WS 22 - 24.

ANSWER KEY

WS 21	WS 22	WS 23	WS 24
1. 1/2	1. 1/2	1. 1/4	1. 1/8
2. 1/4	2. 1/4	2. 1/6	2. 1/2
3. 1/2	3. 1/2	3. 1/3	3. 1/4
4. 1/2			
5. all			
6. 1/2			
7. 1/2			
8. 1/4			
9. 1/2			
10. 6			

The following were members of the Guidelines Committee for Quality Mathematics Teaching during the development of this monograph:

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